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REMARKS

This amendment is responsive to the final official action dated April 1, 2004.

Claims 1-3 were pending in the application. Claims 1-3 were rejected. No claims were allowed by the Examiner.

By way of this amendment the Applicant has amended Claim 1. Claims 2 and 3 remain unchanged.

Accordingly, Claims 1-3 are currently pending.

I. REJECTION OF CLAIMS UNDER 35 USC §103

Claims 1-3 were rejected under 35 USC 103(a) as being unpatentable over US Patent No. 5,661,339 (Clayton) in view of US Patent No. 5,561,208 (Takahashi et al.). The Examiner has stated that Clayton discloses a method of manufacturing a structural frame including the steps of providing a base polymer matrix, net-shape molding the base matrix material into the shape of a structural frame, providing an electronic circuit board having heat generating components thereon, mounting the circuit board to the structural frame with the electronic components in thermal communication with the structural frame and dissipating the heat from the electronic components through the structural frame. The Examiner further stated that while Clayton does not disclose mixing a thermally conductive filler into the base matrix to form a material having a uniform distribution of the filler throughout the entire material, that Takahashi teaches polymer materials having a uniform distribution of filler therein and that the present invention is obvious in light of the combination of these references.

The Applicant has amended the claims of the present invention to disclose a method of manufacturing and assembling an electronic device with a thermally conductive structural frame, wherein the structural frame itself serves as a highly thermally conductive conduit that provides the preferred via for conducting the heat from the interior of the device to the exterior of the device. In this manner, the Applicant is not relying on the fact that all materials in general have some level of thermal conductivity and that as such if sufficient heat builds up within a structure made of any material a portion of that heat by default will bleed out of the device by natural conduction. This is

simply not an advisable method by which to provide reliable heat transfer and dissipation from sensitive electronic components within electronic devices.

The Applicant's inventive method and resulting device clearly can be contrasted in that the method of the present invention includes limitations that a structural frame be formed from a thermally conductive composition that itself acts as the preferred pathway or conduit for transferring heat from the interior of the structural frame to the exterior of the structural frame. In this manner the Applicant is creating a heat conduit for the transfer of the generated heat and is not simply relying on the fact that any material given sufficient heat will eventually conduct a portion of that heat.

The references cited by the Examiner are lacking in several critical elements as related to the claims of the present invention as amended and therefore cannot render the present disclosure obvious. First, the Examiner has asserted that Clayton discloses mounting the circuit board in direct contact with and in thermal communication with the frame (Col. 6, lines 49-53). While the Examiner is correct in stating that the circuit board is in physical contact with the frame, the Applicant fails to locate the disclosure in Clayton relied upon by the Examiner that teaches thermal communication between the circuit board and the structural frame. The Examiner states that Col. 8, lines 40-45 discloses heat generating electronic components disposed on an electronic circuit board. This passage is reproduced below:

> A variety of semiconductor devices may be readily assembled into the module of the present invention by careful tailoring of the molded frame 12 and the composite semiconductor substrate subassembly 32. Typical devices include, but are not limited to, Memory chips (DRAM, AS-DRAMs, Flash-EEprom, ROM, Fast/Slow-Static RAMs, Ferro-magnetic RAM, et. al.), Microprocessor, Application Specific IC's, Gate Array devices, Telecommunication IC's and others manufactured in CMOS, BiCMOS, and other technologies compatible with TTL, ECL, FAST and other logic interface standards.

The applicant cannot find the references in this passage relied upon by the Examiner to state that the Clayton reference discusses heat generation by the listed devices.

Additionally, the Examiner states that Col. 6, lines 49-53 discloses a circuit board in direct thermal communication with a structural frame. Again, this passage is reproduced below:

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> In an alternate embodiment of the present invention, the thin laminate circuit 50 can be attached on or integrated directly into the floor 28 of the molded frame 12. In this embodiment, the cover plate 48 may include an additional thin laminate circuit. Tab leads or pads arrayed along the edge(s) of the circuit 50 can then be directly connected or soldered to appropriately sized and placed termination pads 34 along a shorter stepped ledge 30 or floor 28 of the molded frame 12.

In reading this passage, the Applicant again fails to find the references relied upon by the Examiner to state that Clayton discloses any thermal conductivity relationship between the electronic device, the circuit board and the structural frame.

Finally, the Examiner states that Col. 7, lines 47-50 discloses the dissipation of heat through the structural frame. Again, this passage is reproduced below:

> Maximum thermal conduction may be achieved by incorporating open windows 62 within the thin laminate circuit 50 and if present, adhesive 52, to allow backside chip attachment directly to the cover plate 48, as shown in FIG. 9. Chip attachment can be accomplished using eutectic alloying materials (e.g., solder), metal filled epoxy or other thermally conductive adhesives. This technique would preferably be performed on a cover plate 48 formed from material exhibiting the same or approximate coefficient of thermal expansion as the chip devices attached thereon to promote better mechanical reliability of the attachment bondline. An alternative approach to lower thermal resistance makes use of small thermal vias 64 formed as an integral part of the thin laminate circuit 50. Strategically arrayed under selective chip mounting sites, as shown in FIG. 10A, these structures provided either solid conductive posts or small openings through the circuit 50 and adhesives 52, into which a thermally conductive material may be emplaced, bringing intimate thermal, metal-to-silicon, contact between the cover plate 48 and semiconductor device 54 at localized areas beneath semiconductor devices 54. Another enhancement of thermal convection, or transfer of heat into the ambient air surrounding the module, involves the incorporation into the external surface 48' of the cover plate 48, a surface finish 66 or uniform array of small polygon structures 68 impressed into the surface, for the purpose of increasing the total external surface area of the cover plate 48, as shown in FIG. 11.

This entire passage is related to providing vias in the covering of the device or including additional insert molded metal components such as spreader plates and small conductive posts or small openings through the substrate to enhance thermal convection and heat transfer. This passage discusses that the thermal convection may be improved by enhancing the surface area of the ***cover plate*** and not the ***structural frame***. The

cover plate and the structural frame are two distinct and separate elements of the disclosure. The cover plate is further defined as being a thin metal plate (Col. 5, line 51), not an injection molded polymer. Therefore the disclosure relied upon by the Examiner was selected from the properties of two distinct and separate elements of the disclosed device. First a structural frame of a non-thermally conductive polymer and second a thin metal cover. There is absolutely no disclosure within the Clayton reference that suggests, teaches or imputes that the structural frame be used as a heat dissipating structure. Nor is there any disclosure that the function of these two elements may be combined in any manner to create an integrated structural frame for the dissipation of heat generated by the electronic components mounted thereon. In reading this passage, the Applicant again fails to find the references relied upon by the Examiner to state that Clayton discloses any provisions that relate to the modification or manufacture of a structural frame that serves to act as a thermal conduit from the interior of the device to the exterior of the device.

As a point of clarification, the Applicant would like to direct the Examiner's attention to the fact that the present invention is directed to taking a packaged electronic chip, such as the one disclosed in Clayton, and further incorporating that chip onto a circuit board within an electronic device that includes a structural frame that serves as a thermally conductive pathway from the interior of the device to the exterior of the device.

There is simply no disclosure within Clayton related to the use of the structural frame as a conduit to transfer heat from the circuit board. In fact, the structural frame is made from injection molded liquid crystal polymer with native properties that are considered to be thermally insulative. Should the native thermally conductive properties of this material be relied upon for dissipation of waste heat as appears to be the position taken by the Examiner, the device would simply fail before sufficient heat was dissipated. For this reason, the Clayton disclosure is silent regarding thermal communication between the frame and the circuit board. More specifically, this feature does not exist and is therefore not referred to in the Clayton reference. It is not until the Examiner viewed the present invention regarding the addition of fillers into the polymer base matrix that the Examiner engaged in hindsight reconstruction to impute the concept of thermal communication through a virgin, unfilled liquid crystal polymer into the Clayton disclosure.

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The Examiner further states that in view of Takahashi it would have been obvious to fill the polymer structural frame in Clayton with conductive filler to arrive at the present invention. The Examiner refers to Col. 13, lines 19-40 for support of this assertion. This passage Is reproduced below:

> The monofunctional acrylate monomers may be, for example, n-butyl acrylate, isoamyl acrylate, 2-hydroxyethyl methacrylate, 2-hydroxypropyl methacrylate, 2-ethylhexyl methacrylate, phenoxyethyl acrylate, phenoxypropyl acrylate and other higher alkyl acrylates. Acrylates which have a side chain of about 4-6 carbon atoms are preferable to reduce the cure shrinkage of the ultraviolet curing coating agent.

Presumably, the Examiner is of the understanding that the reference to a side chain of 4-6 carbon atoms found in line 24 indicates the use of carbon fiber filler. In actuality, the disclosure refers to the use of an acrylate monomer having a chemical structure that includes an atomic structure having a side chain composition including 4-6 cross linked carbon atoms. This disclosure is related to atomic level operations that are not even relevant to the present disclosure. The disclosure states that a monomer having this particular structure would be useful as a coating agent for the reduction in shrinkage of a part using ultraviolet curing processes. ***Chains of 4-6 cross linked carbon atoms are not carbon fibers loaded into a base polymer matrix to enhance the thermal conductivity of the composition***. There is no disclosure relative to the loading of a polymer base matrix with a filler material to create a composition that is both injection moldable and includes inherent thermally conductive properties. Further the is no disclosure relative to the loading of a polymer matrix with a carbon fiber.

If the Clayton and Takahashi references are combined the end product would include a structural frame having a polymer base matrix that did not shrink during ultraviolet curing operations. There is no possibility that the combination would result in a polymer matrix filled with a thermally conductive filler thereby rendering the present invention obvious.

Specifically, since there is no disclosure or teaching in either the Clayton or Takahashi references that suggests that they are combinable they cannot be combined to render the present Invention obvious. Further since the combination of the two references does not disclose the present invention, one skilled in the art would not have

the motivation to combine the references to arrive at the present invention. Thus the disclosures of Clayton and Takahashi teach away from such a combination under §103. Obviously, one skilled in the art that desired a thermally conductive injection molded polymer structural frame would not use the reduced shrinkage method provided in Takahashi to enhance the thermal conductivity of the structure disclosed in Clayton. Therefore, the references cited by the Examiner cannot be combined to render the present invention obvious and this basis for rejection is no longer maintainable. Reconsideration and withdrawal of this rejection is respectfully requested.

II. CONCLUSION

Accordingly, the Applicant asserts that all of the pending rejections regarding the claims of the present Application have been traversed and that the present amendment by complying with the requirements set forth by the Examiner has placed the application in condition for allowance. Therefore, the Applicant asserts that Claims 1-3 are in condition for allowance and the application ready for issue.

Corresponding action is respectfully solicited.

PTO is authorized to charge any additional fees incurred as a result of the filing hereof or credit any overpayment to our account #02-0900.

Respectfully submitted,

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